

**Town of Concord
Watershed Resource Protection Plan
Nagog Pond**

August 2011(revised)

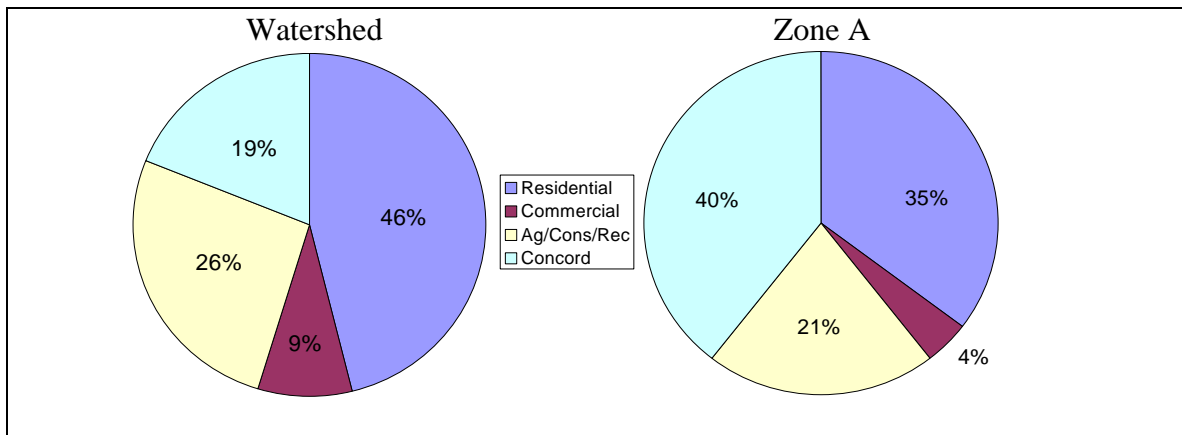
WATERSHED RESOURCE PROTECTION PLAN SUMMARY

This revision to the Town of Concord's Watershed Resource Protection Plan serves as an update to the July 1998 Watershed Protection Plan (last amended August 30, 1991). This document contains updated maps of the Nagog Pond Watershed to identify current and potential contamination sources along with a Watershed Characteristics and Land Use Map (Map #1).

NAGOG POND OVERVIEW

Nagog Pond is located approximately 5 miles north of Concord in the towns of Acton and Littleton, MA. Nagog Pond is a great pond with the majority of recharge from surface runoff, ground water recharge (thought to be through fractures) and very limited tributary flow during times of high precipitation. Nagog Pond has a surface area of just under one half square miles (0.44sq mi) with corresponding watershed area of only 1.25 square miles.

The watershed is comprised of low density residential, conservation/protected land and a small amount of commercial land in Nagog Park. As of February 2011 an inventory of land-use activity within the Nagog Pond Watershed is as follows:



In 1990, Nagog Park, a 47 acre commercial development located within the watershed due east of Great Road, was designed and constructed. As part of this project, a storm water collection system was installed, diverting stormwater out of the Nagog Pond Watershed northeast into the Nashoba Brook Watershed.

REGULATORY DEFINITIONS - SURFACE WATER PROTECTION AREAS

Zone A

- the land area between the surface water source and the upper boundary of the bank;
- the land area within a 400 foot lateral distance from the upper boundary of the bank of a Class A surface water source (Nagog Pond)
- the land area within a 200 foot lateral distance from the upper boundary of the bank of a tributary or associated surface water body.

Zone B

- the land area within ½ mile of the upper boundary of the bank of a Class A surface water source (Nagog Pond), or edge of watershed, whichever is less, and
- shall always include the land area within a 400-foot lateral distance from the upper boundary of the bank of the Class A surface water source.

Zone C

- the land area not designated as Zone A or B within the watershed of a Class A surface water source as defined at 314 CMR 4.05(3)(a).

Because the Nagog Pond Watershed is relatively small in area, a majority of the watershed is delineated and subsequently managed and protected as Zone A (see Map# 1).

For more detailed historical description, please reference the July 1998 Watershed Protection Plan, available for viewing at Concord Water and Sewer Division, 135 Keyes Road, Concord, MA 01742.

LAND USE ASSESSMENT

Note: Specific action items are underscored in each narrative and summarized in a table in Appendix 1.

Agricultural

Orchard: In 2000, the Town of Littleton purchased approximately 48 acres of watershed land (from the Morrison Family) which is zoned for agricultural use. The original residence located on this property was subdivided out and sold to a private entity as a single family residence. The Town of Littleton currently leases the remainder of this land to a private contractor who continues to use approximately 28 acres of this land as active orchard, doing business as Nagog Hill Orchard. An additional 20 acres of this land immediately borders Nagog Pond and has been allowed to grow in, undisturbed, since approximately 2005. This low maintenance management strategy has effectively eliminated this area from becoming an attractive nuisance for both human (recreational) and waterfowl.

Concord Public Works, Water and Sewer Division (CPW) continues to communicate with Orchard management staff on an as-needed basis and performs a more formal site visit and tour annually. The orchard is required to submit a yearly Massachusetts Department of Agricultural Resources Pesticide Use Report by May 15th. Copies of these reports are submitted directly to CPW from Orchard management, upon CPW's request.

Proper storage and containment of onsite chemicals like pesticides and fertilizers continue to be evaluated each spring (depending on available resources) using the guidance of MassDEP Drinking Water Regulations 310CMR 22.00, Massachusetts Department of Agricultural Resources regulations and the Town of Littleton Bylaws.

While it is understood that the Orchard has historically drafted water from Nagog Pond to supplement seasonal irrigation needs, CPW has never issued nor has been made aware of any formal rights which would allow for such a withdrawal. Due to the ephemeral nature of this operation, CPW is also not aware of the actual volume of water which has been drafted during any given year. Within the past decade, CPW's primary focus has been placed in reducing potential adverse impacts relating to water quality. The noted withdrawal is presently performed using a portable, tractor mounted pumping unit which is parked on the shore of Nagog Pond. This system conveys water to an irrigation pond which is then pumped directly to the orchard and a drip irrigation system. A small containment vessel has been noted to be positioned beneath locations where fuel or fluid could be released from the tractor.

Horse Stable: The residence at 12-14 Breezy Point Road maintains a horse stable which is used to house approximately 5 horses. Historically, the owner of this residence has not been especially receptive to communications initiated by CPW

staff; however, some improvement has been noted more recently. CPW continues to provide this owner with guidance and encouragement as to Best Management Practices (BMP's), specifically for handling of manure. Periodic site visits are made during the warmer months. As time permits, CPW is interested in evaluating and pursuing potential funding sources/incentives to help encourage a more 'enhanced' manure management system.

Stormwater Management

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION (Mass DOT) - Great Road Reclamation Project: In 1999, MassDOT initiated a road reclamation project which included a large section of Great Road which was located within the Nagog Pond Watershed. CPW provided design input and engineering support to ensure catch basins located within the limit of work were effectively diverted away from Nagog Pond and into Little Nagog Pond and that a double-height granite curb stop was installed. Little Nagog Pond is hydraulically separated from Nagog Pond with its overflow directed to Nashoba Brook Watershed. The only catch basin located on Great Road which is not diverted to Little Nagog Pond is located near the parking lot of a commercial property (presently identified as the "Tire Barn"). This catch basin is furnished with an oil/gas water separator and it discharges to a retention swale located at the intersection of Nashoba Road and Great Road which eventually flows to Nagog Pond (only under extreme precipitation events).

Winter road practices: The stormwater management controls noted above are especially noteworthy given concerns and issues generally attributed to winter maintenance activities. To this end, CPW continues to monitor potential impacts and keep Mass DOT engaged with respect to implementation of best management practices when it come to application rates and maintenance practices.

Road Salting – Over the past 10, years sodium concentration in Nagog Pond appears to be stable ranging from ~17-25. The variation does not appear to correlate to seasons or precipitation events.

Road Sanding – Concord continues to work with Massachusetts Department of Transportation to ensure proper catch basin maintenance along Great Road. If there are any catch basins that are not draining properly Concord will contact Mass DOT.

Municipal Stormwater Management: Four (4) catch basins located within the Town maintained Right of Ways, specifically along Nashoba Road and Nagog Hill Road, drain directly towards Nagog Pond. All other municipal catch basins are directed into properly maintained infiltration swales.

All catch basins within the watershed are inspected in the spring and fall by CPW staff (at least once during wet weather conditions) to ensure that they are flowing

and properly maintained. If structural or operational issues are identified, the responsible department/agency is contacted.

Groundwater Seepage: In 2007, an unknown source of groundwater appeared to be seeping onto and across Great Road in the general area of Nagog Woods Condo and Apartment Complex. This was reported by CPW to Mass DOT (formerly MA Highway) shortly after upgrades were made to Great Road to accommodate the Avalon Acton apartment development project (adjacent to Nagog Park). In December of 2008, seepage was again noted to emanate in this same general area. As an emergency measure taken to prevent ponding and potentially dangerous icing conditions from occurring on Great Road, the flow was diverted into a small, newly created drainage swale which feeds directly into Nagog Pond.

The seepage appears to flow steadily in the spring and after rainfall but has little to no flow in the late summer, fall or winter. Water quality samples have been taken at the site and indicate a fluctuation from low to high sodium and bacteria counts. No correlation has been made between concentrations of either sodium or bacteria and time of year or amount of precipitation. Mass DOT has been contacted directly and informed of water quality concerns.

Seepage will continue to be checked quarterly and water quality sample will be taken if flowing.

Slope Stabilization

CPW continues to monitor for unusual or problematic erosion conditions within the Nagog Pond Watershed. Staff have identified a potential concern near the southern side of Nagog Pond close to Nagog Hill Road (see Map #1). The slope is beginning to erode during heavy precipitation events as observed during the spring of 2010. Concord is planning to evaluate effective slope stabilization methods and will share these with Littleton Highway Department in an effort to encourage them to integrate appropriate slope stabilization work into future roadway improvements.

Development

Quail Ridge Country Club located at 354B Great Road, Acton, is situated on a 140 Acre property which has and continues to be actively evaluated for potential re-development. The most current plan includes 174 senior residential units on approximate 56 acres with an adjacent golf course. This property is currently bank-owned and under contract with Putle Homes.

While most of this land is located outside of the Nagog Pond Watershed, a small portion (c. 1 acre) of this property falls within the Nagog Pond Zone A. CPW will continue to follow potential development plans for this parcel and, as a direct abutter, will attempt to work with both the developer and Acton Planning Board to ensure any proposed changes to this property, especially in the area that lies

within the Zone A, is done with due consideration of Nagog Pond protection interests.

Also, the Town of Acton has expressed an interest in leveraging the developer to create recreational trails as part of this development with an interest in connecting them to existing trails located within the Zone A of Nagog Pond. Concord remains concerned that such connectivity will increase foot traffic and recreation which may increase erosion or potentially introduce exotic species.

15 Great Road, Littleton: Currently there is only one parcel zoned for residential use within the watershed that is privately owned and undeveloped. It covers a total of 54 acres with 13 acres in the Nagog Pond watershed. Over the past decade, there has been several development proposals for this property, however non have been realized.

Concord will continue to track development proposals and work with the Town of Littleton Planning to ensure any changes within the Nagog Watershed are appropriately permitted and where approved, mitigated.

Wildlife Impacts/Management

Beavers: There are currently a number of beaver shore lodges located around Nagog Pond (see Map #1). Concord monitors changes to the known beaver lodges (at least twice per year) and, when activity is identified, works with a licensed beaver trapper in accordance with the Massachusetts Division of Fisheries and Wildlife regulations. The current trapping season is November 1-April 15. Emergency trapping activities performed outside this season require filing with MassDEP for a Determination of Threat to Public Water Supply due to Beavers or Muskrat.

Water Fowl: There are a number of birds (20-50) that roost in the northern quadrant of Nagog Pond, close to Great Road. Concord will continue surveillance of watershed lands which can create open roosting sites or food sources (such as improperly maintained dumpsters in the Nagog Park area). During routine inspections, bird harassment activities will be supported by boat. If the resident population of birds continues to grow Concord will re-deploy additional bird mitigation methods such as shell crack guns.

There is no evidence that area residents are feeding the birds or doing anything that would encourage the gulls or other waterfowl to continually visit the Nagog Pond Watershed.

Public Education/Awareness

Direct Mailings: Concord distributes educational flyers/mailings to residents within the Nagog Pond Watershed annually and sometimes more frequently as resources permit. The content of these mailings are intended to maintain general

awareness of best management practices for residential land-use activities which occur within the water resource protection area. In the past, topics have included;

- Proper septic tank maintenance
- Proper lawn care
- Accepted and prohibited recreational activities
- How residents can help protect Nagog Pond
- Proper hazardous waste and medication disposal

Ideas for future outreach are educational information on

- Management of dog and livestock waste
- Proper household garbage storage and composting

One-on-One Communications: The residence at 12-14 Breezy Point Road maintains a horse stable which is used to house approximately 5 horses. Historically, the owner of this residence has not been especially receptive to communications initiated by CPW staff; however, some improvement has been noted more recently. CPW continues to provide this owner with guidance and encouragement as to Best Management Practices (BMP's), specifically for handling of manure. Periodic site visits are made during the warmer months. As time permits, CPW is interested in evaluating and pursuing potential funding sources/incentives to help encourage a more 'enhanced' manure management system.

Household Hazardous Waste Disposal: Concord has invited residents within the Nagog Pond Watershed to participate in the Town of Concord's Hazardous Waste and Unwanted Medication collection when offered (generally twice per year).

Underground Storage Tanks: At this time Concord is unaware of any Underground Storage Tanks located within the watershed.

Watershed Surveillance

Concord tries to use a direct and personal approach to residents and individuals whom have the most contact with the Nagog Pond watershed. During routine inspections, Concord staff will often stop and talk to those people they meet along the way or knock on residents' doors to say hello and reiterate the importance of protecting Nagog Pond.

Inter-municipal Coordination

Concord Public Works maintains a solid and professional working relationship with municipal departments within both Littleton and Acton including Police Departments, Fire Departments, Planning and Engineering Department, Littleton Conservation Trust, Conservation Commission, Health Department, Highway Departments (including Mass DOT), etc.

Nagog Pond Dam Improvements

Nagog Pond Dam is located on Nagog Pond in Acton, Massachusetts and is listed on the National Inventory of Dams. The Dam is a 15 foot high, 168 foot long concrete gravity section dam containing a sharp-crested spillway with a steel weir plate. The dam was originally constructed in 1909 as part of the development of Nagog Pond for use as an active water supply for the Town of Concord. The dam is regulated by the Massachusetts Department of Conservation and Recreation, Office of Dam Safety (DCR) as a Class III (or low hazard), large size dam. In November 2008, the Town of Concord was directed by the DCR to conduct a Dam Safety Phase I and II inspection.

Pare Corp (Foxborough, MA) performed a Phase II Dam evaluation in accordance with the Office of Dam Safety. Their findings indicate the Dam is in poor condition. Their recommendation includes the rehabilitation of concrete dam, intake piping, spillway, gate/control valves. Pare Corp has been tasked to generate design specifications for necessary improvements with anticipated construction to be scheduled in 2012-2013 (subject to availability of funding).

Nagog Pond Intake Pipe Inspection

The structural and operational condition of the Nagog Pond intake pipe, installed in 1909, is of questionable integrity. CPW is planning for an underwater inspection of the intake line for the purpose of determining rehabilitation or replacement needs.

WATERSHED SAMPLING PLAN

Nagog Pond is generally a well mixed reservoir with little to no significant stratification or seasonal turnover events that negatively effect water quality. Based upon decades of water quality monitoring activities, water quality within Nagog Pond is considered to be relatively stable throughout the year. While sample methodologies and strategies have varied and evolved over the years, the current program is summarized below.

Water Quality Monitoring Plan (Base)

Sample Location: Raw Water Sample Tap (before any treatment)

Parameter	Frequency
Fecal Coliform Bacteria	As req. by 310 CMR 22.00
Cryptosporidium and Giardia	Monthly
Secondary Contaminants	Monthly
Sodium	Quarterly
Inorganic Contaminants	Yearly
Volatile Organic Compounds	Yearly
Synthetic Organic Compounds	Yearly
Chlorophyll a	Monthly
Nitrate and Nitrite as N	Quarterly
Total Phosphorus	Quarterly

Enhanced Water Quality Monitoring

In the event that any of the General Water Quality parameters measured exceed a Maximum Contaminate Level (MCL), grab samples will be taken at the seven locations as noted on Map #3 to help identify a potential source(s). Sampling parameters will be determined according to the specific exceedance noted.

Nagog Pond Characterization

As staffing and time permits, during the warmer months Concord will attempt to perform a monthly water quality profile of the pond using seven sampling locations (Map #3). This monitoring initiative will include surface and/or depth samples to help characterize Nagog Pond Quality. This data will be evaluated to help identify any potential water quality problems that may have a point source such as failing septic systems or nutrients from runoff.

Parameters of interests will include:

- ◆ Fecal Coliform Bacteria
- ◆ Sodium
- ◆ Nitrate and Nitrite as N
- ◆ Total Phosphorus
- ◆ Turbidity
- ◆ Dissolved Oxygen

WATERSHED PROTECTION AND MANAGEMENT CONTROLS

Concord has purchased over 89 acres of land within the Nagog Pond Watershed and works with other municipal and private land owners to aid in the protection of Nagog Pond water quality. For all intent and purpose, potential changes in land-use activities are de-minimus as the watershed has effectively reached build-out. Concord has not purchased any new land for several decades.

Watershed Control

Currently Concord owns 19% of the land in the Nagog Pond Watershed and 40% of the land in the Nagog Pond Zone A.

Concord works closely with land owners within the watershed and specifically within the Nagog Pond Zone A in regards to land management. Concord will actively communicate with residents to express our interest for the outright purchase of the property or the purchase of a conservation restriction, which limits the future use and development of the parcel to protect Nagog Pond water quality.

Currently, the land that Concord Water owns is being protected and has no plans for development or sale.

Municipal Land Use Improvements

Concord works closely with the towns of Littleton and Acton MA and also with Massachusetts Department of Transportation to evaluate opportunities to improve

local road and shore conditions. Currently, there are no municipal land use issues within the watershed to note.

Public Access and Recreation Controls

Land owned and controlled by the Town of Concord is posted with signage which reads, 'No Trespassing – Public Water Supply'. These signs are located at key locations on existing trails and around the shore where public access is prohibited. These signs are used for public awareness, deterrents and when required, to support enforcement actions.

Daily Watershed inspections take place year round. The level and depth of inspection varies by the weather, season and time of day. A watershed inspection log is kept by Concord staff.

Wildlife Management

Please reference: Wildlife Impacts/Management.

In-Lake Management

Please reference: Nagog Pond Characterization.

At this time, there is currently no evidence of aquatic invasive plants in Nagog Pond. Downstream of the dam in wetland areas there is phragmites that will be evaluated at the time of dam repair and restoration.

REGULATORY CONTROLS

State and Federal

Concord makes its best effort to comply with all State and Federal water supply protection regulations.

Local

Neither Acton nor Littleton have a surface water supply protection bylaw in place because they obtain their drinking water supply from ground water sources located in different watersheds. Written requests to incorporate surface water supply protection measures in support of Concord's Nagog Protection strategy have been made without success.

EMERGENCY PLANNING

Concord has a working Emergency Response Plan that is updated yearly and is currently working with Pare Corp. to develop a final draft Emergency Action Plan as an Appendix to Concord's Emergency Response Plan that focuses on imminent failure of the Nagog Pond Dam.

Coordination with Acton and Littleton First Responders along with the State Police will be done on an as-needed basis and as time permits to discuss potential Nagog Pond Watershed and Dam issues and or emergencies.

Mass DOT has made upgrades to the infrastructure along Great Road to prevent automobile accidents from having a negative impact on Nagog Pond including

- Catch basins direct water and any potential spills away from Nagog Pond
- Reinforced guardrail/guiderail – Supports place every 2 ft. vs. the normal 4 ft.

EDUCATION

Please Reference section entitled “Public Education/Awareness”

STAFFING

All Concord Water and Sewer staff assists with the implementation of the Nagog Pond Watershed Resource Protection Plan to varying degrees. The following is a list of the various job titles and how each position assists with Nagog Pond.

Water/Sewer Superintendent (full time)

Responsible for all aspects of Nagog Pond Watershed Protection Planning efforts.

Environmental and Regulatory Coordinator (full time)

Maintains Nagog Pond Watershed Resource Protection Plan

Monthly dam inspection

Water Quality sample collection and data analysis

Seasonal Employee (part time)

Assists Environmental and Regulatory Coordinator in summer time Nagog Inspection routine sampling and watershed sampling.

Public Works Supervisor (full time)

Supports Environmental and Regulatory Coordinator in Watershed sampling and inspection.

Water Systems Operator (full time)

Daily Nagog Pond watershed inspection on routine site visits.

Nagog Pond Caretaker

One individual that lives on Nagog Pond that is available to be a watchful eye over Nagog Pond. This individual is authorized by the Town of Concord to perform the following duties;

- Weekly patrol of Nagog Pond to assess general watershed condition (routine)
- Event initiated patrol of pond (to response to or assess unauthorized activity)
- Watchman of Town of Concord watershed protection equipment (including motor boat, fuel, life-vests, sample equipment, etc.)

NAGOG POND WATERSHED RESOURCE PROTECTION PLAN UPDATES

The Nagog Pond Watershed Resource Protection Plan shall be updated at a minimum **every three years** per MassDEP Guidance: Developing a Local Surface Water Supply Protection Plan.

Nagog Pond - Water Resource Protection Plan

Appendix #1

Action Items Summary

LAND USE ASSESMENT

ACTION ITEM	FREQUENCY
Agricultural	
<i>Orchard</i>	
Communication	On-going
Tour	Annual
Pesticide and fertilizer review	Annual in spring
<i>Horse Stable</i>	
Site Visit	Annually
Stormwater Management	
General Catch Basin inspection	2x year
<i>Groundwater seepage</i>	
Observation	Quarterly
Water Quality Sampling	As needed
Slope Stabilization	On-going
Development	
<i>Quail Ridge Country Club</i>	On-going
<i>15 Great Road, Littleton</i>	On-going
Wildlife Impacts/Management	
<i>Beavers</i>	2x year and as needed
<i>Waterfowl</i>	Daily
Public Education and Awareness	
<i>Direct Mailing</i>	1x per year
<i>One-on-One Communication</i>	On-going
<i>Household Hazardous Waste Disposal</i>	2x per year
<i>Underground Storage Tanks</i>	n/a
Watershed Surveillance	On-going
Inter-municipal communication	On-going
Nagog Pond Dam Improvements	2012-2013
Nagog Pond Intake Inspection	estimated for 2012

WATERSHED SAMPLING

General Water Quality Assessment	On going
Enhanced Water Quality Monitoring	As Needed
Nagog Pond Characterization	Monthly during warmer months

Nagog Pond Watershed

Map #1

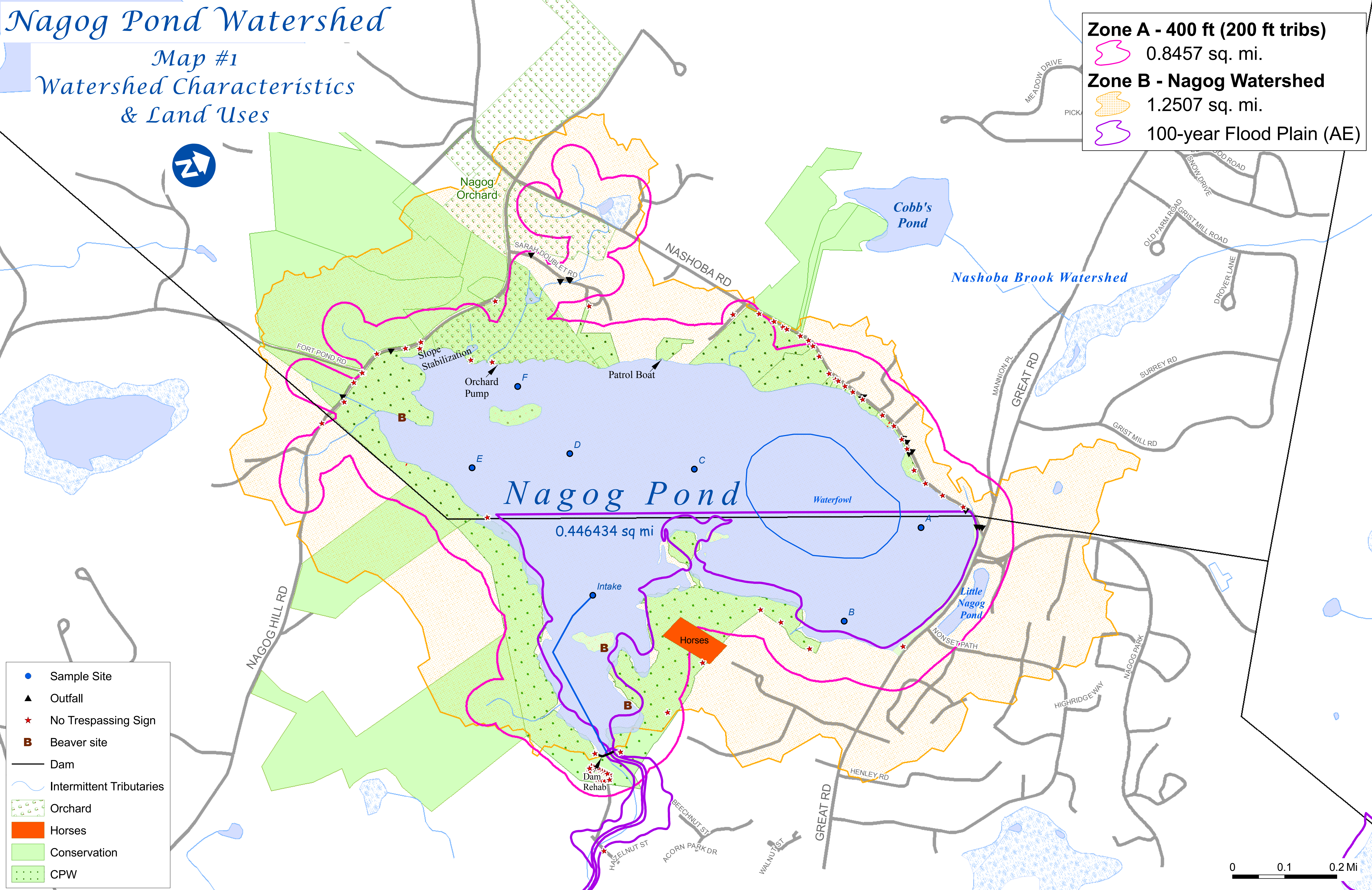
Watershed Characteristics
& Land Uses



Zone A - 400 ft (200 ft tribs)
 0.8457 sq. mi.

Zone B - Nagog Watershed
 1.2507 sq. mi.

100-year Flood Plain (AE)



Sample Site

Outfall

No Trespassing Sign

Beaver site

Dam

Intermittent Tributaries

Orchard

Horses


Conservation

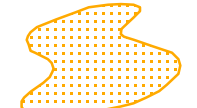
CPW

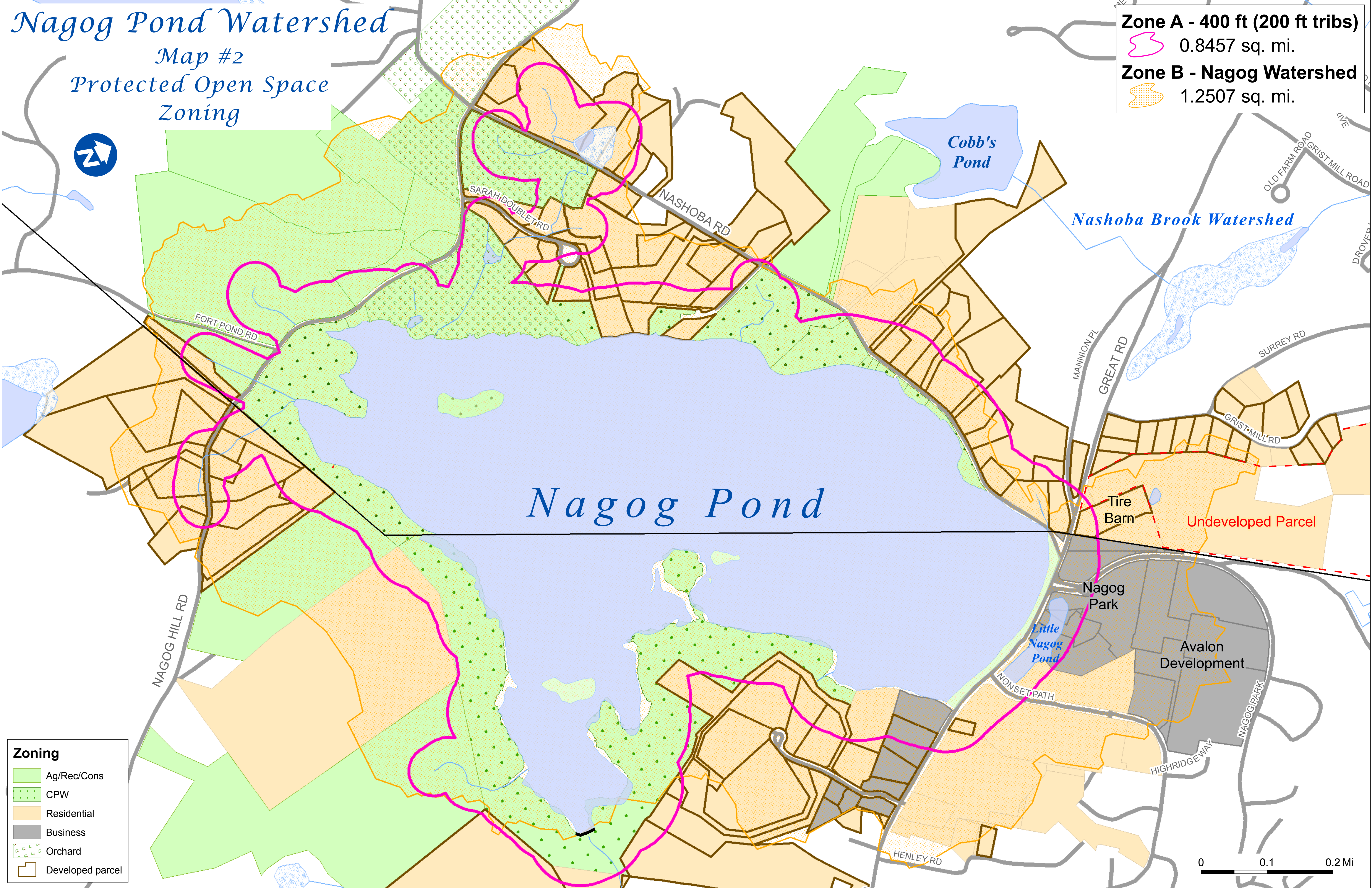
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Nagog Pond Watershed





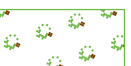

Map #2
Protected Open Space
Zoning

Zone A - 400 ft (200 ft tribs)
 0.8457 sq. mi.

Zone B - Nagog Watershed
 1.2507 sq. mi.



Zoning

-  Ag/Rec/Cons
-  CPW
-  Residential
-  Business
-  Orchard
-  Developed parcel

Nagog Pond Watershed

Map #3

Water Quality Sampling Locations



Zone A - 400 ft (200 ft tribs)

0.8457 sq. mi.

Zone B - Nagog Watershed

1.2507 sq. mi.

